



Organization(s): IRIS, Swinburne Univ of Tech,

Griffith University; Austin; Medical Institute

MTO

Composite

CAD

Title: Scaling Relationships for Biomolecules Adhesion and Activity on Polymeric Surfaces

Duration: September 2000 - September 2002

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Objective

The proposed project aims at delivering scaling relationships regarding the non-specific attachment of biomolecules on the walls of the microfluidic devices and the related impact on hydrodynamic design and reactivity/sensitivity prediction.

Technical Approach

- Conceptual basis. The central feature of the proposed research is the dual-study of the attachment and bioactivity of biomolecules on polymeric surfaces.
- The first line of (reduced number of) experiments will study the actual physical attachment and bioactivity of classes of biomolecules on combinatorially fabricated structures. These areas will have combinatorially-different (i) grades of hydrophobicity; (ii) types and concentration of bio-relevant groups on the polymer surfaces; (iii) types of biomolecules that attach on the polymer surface, i.e. proteins, DNAs, etc. (iv) concentration of these in solution; and (v) types of biomolecular interactions, e.g. biotin-avidin for the conditions combinatorially-visited above.
- The second line of “experiments” will reproduce and enlarge the above experimental plan using the tools on molecular modeling/simulation (i) with a much larger pool of variables –especially those relating to the variables [iii] to [v] above; and (ii) using the above physical experiments as validation database.

Major Challenges

- Coverage of the whole range of hydrophobicity and surface chemistry using photosensitive polymers (resists)
- Rapid and effective quantification and prediction of biomolecule attachment and bioactivity on combinatorial arrays
- Open and upgradable architecture of the database/scaling relationships; accepted standards

6-Month Milestones

- Combinatorial arrays for surface properties and attached biomolecules; pilot physical database
 - Computational method for predicting biomolecules attachment on polymer surfaces
 - Statistical comparison of physical-computational reduced database re. attachment/ first cut scaling relationships and re bioactivity refined scaling relationships
 - Prediction and validation of attachment and bioactivity; database architecture and upgradeability
 - Database standardization; web-accessibility; upgradeable scaling relationships
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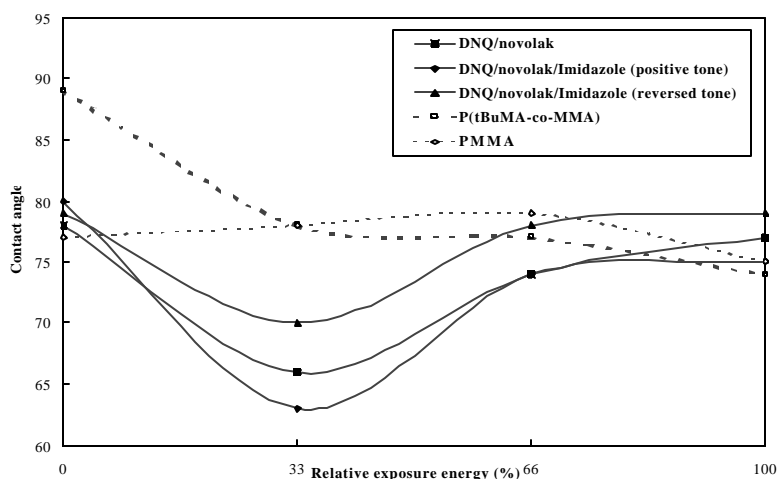


Figure 1. Variation of the hydrophobicity of two resins versus exposure energy.

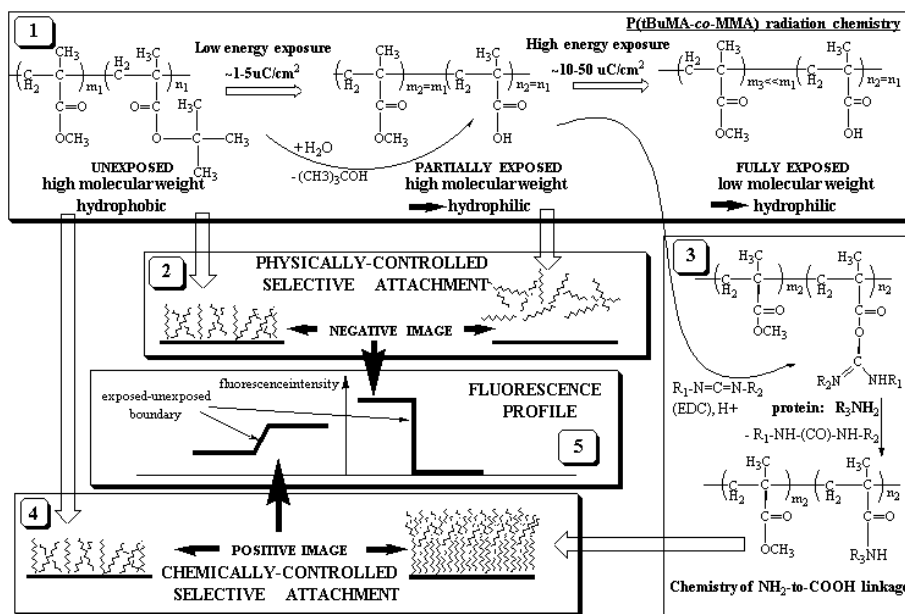


Figure 2. Mechanisms of protein attachment on deep-UV resists

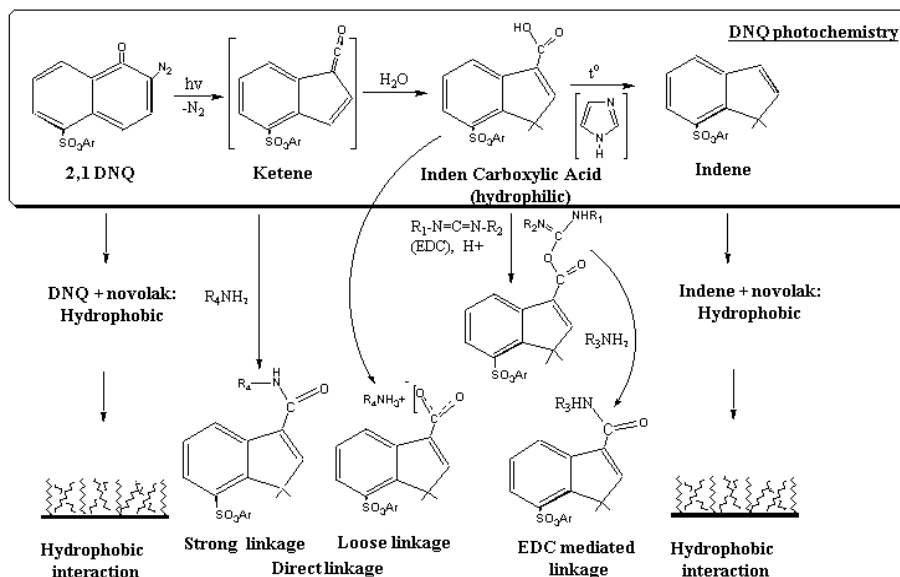


Figure 3. Mechanisms of protein attachment on photoresist surface